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AUTHOR Froman, Robin D.; Owen, Steven V.
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ABSTRACT

Nursing curricula and licensing examinations have shifted toward the skills and processes of nursing. When these components are overhauled, their predictive relationship must be reexamined. This research tests the causal influence of several antecedent and achievement variables on licensure test performance. A path model is developed from a theory of school learning, and the causal connections within the model are validated and cross-validated. Few significant paths are retained. Student age and transfer status show important influences on measures of school achievement and on licensure scores. Further, one broad measure of school achievement has a substantial direct effect on licensure scores. (Author)

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TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Causal Influences of Selected Educational Variables on Nursing Licensure Scores*

Robin D. Froman and Steven V. Owen
University of Connecticut

PERSPECTIVES AND OBJECTIVES. Eighteen years ago the American Nurses Association proposed a four-year university based program as a requirement to become a registered nurse. The Association suggested that such an education should produce a nurse with a more diverse, liberal arts preparation than was possible with the typical hospital-based program. This broader background was thought to improve professional nurses' problem solving skills. After that proposal, the National Council Licensure Committee determined to revise the National Council Licensure Examination for Registered Nurses (NCLEX) to emphasize the nursing process model of care (Infante, 1982). It was argued that a testing shift toward problem solving would improve the relevance of the Licensure examination. The test was to be based on a comprehensive critical incident study of nursing behaviors from over 12,000 documented episodes where nursing behaviors significantly affected care (Sanders et al., 1983).

The new NCLEX was first administered in July, 1982 and has been administered three subsequent times. There are no empirically based concurrent, construct or predictive validity data available to date regarding the exam. The descriptive data published suggest that the national passing rate of candidates taking the exam is generally on par with the results of the previously used testing format (Anon., 1983a) with the exception of California candidates. In that state the passing rate is the lowest in five years, possibly the lowest of all time. This situation disturbed the California State Board of Registered Nurses enough that they promised to develop their own test if a validation study of the NCLEX revealed cultural bias or a lack of job related validity (Anon, 1983b). Progress on the proposed validation study has yet to be reported.

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Following the ANA proposed requirement of a four year university BSN degree for registered nurses and the anticipated alteration in the NCLEX evaluation of prospective nurses, the University of Connecticut (UCONN) began an evalua- tion and revision of its undergraduate nursing curriculum. The restructured curriculum is based on an integrated educational model rather than a separate systems approach common in nursing schools. In 1976, the first Bachelor of Science in Nursing (BSN) class prepared in the revised curriculum was graduated. July, 1982 marked the first occasion that a UCONN graduating class was examined with the newly revised NCLEX. A second graduating class from the UCONN BSN program sat for the nursing boards administered in July, 1983.

The general objective of this research is to determine the extent to which variation in NCLEX scores can be explained by a set of antecedent variables. The arrangement of the variables follows Bloom's (1976) Model of School Learning. Bloom proposed that learner entry characteristics interact with instructional variables to cause learning outcomes. In our research, several variables corresponding to parts of Bloom's model are incorporated into the causal modeling technique of path analysis.

METHOD. The use of correlational data to test causal models requires explicit hypotheses about the causal flow of variables in consideration. The recursive path model described by Kenny (1979), using standard multiple regression analyses to test the causal assumptions, was used in the research described here. Our path model tests the direct and indirect influences of selected student entry characteristics and achievement in liberal arts and nursing courses on NCLEX performance.

Specifically, student age, SAT-math and SAT-verbal, and transfer status are considered as entry characteristics. Course achievement variables include three constructed grade-point averages: a nonnursing score (GPA-GEN), based on supporting course grades (e.g., pharmacology); a nursing course index (GPA-NURS), based on grades in lecture courses presenting information on the nursing process and the crisis model of nursing; and a nursing clinical course index (GPA-CLIN), based on faculty ratings of student performance in clinical settings. GPA-GEN reflects 28 credit hours; GPA-NURS, 16 credit hours; and GPA-CLIN, 20 credit hours. Table 1 gives means and standard deviations for all of these data.

Insert Table 1 and Figure 1 about here.

The fully saturated eight-variable path model is shown in Figure 1. Bloom's theory gives rough direction to the sequence of variables, in which entry characteristics and the quality of students' educational preparation determine learning outcomes.

In the original path model, not shown here, all four entry characteristics were treated as exogenous variables. (Exogenous variables are influenced by no other variables in the path model; endogenous variables, by comparison, are always influenced by other variables under consideration.) Further reflection and model testing led to the revised model shown in Figure 1, where transfer status is converted from exogenous to endogenous. In this revised model, age is now allowed to influence transfer status.

DATA SOURCES: SAMPLE AND INSTRUMENTS. Validation data were gathered on 72 UCONN BSN graduates who completed the NCLEX in July 1982. All students had attended UCONN for a minimum of four semesters. Half of the sample had applied to the nursing program upon admission to the university; the other half gained admittance as either upper division students or transfer students.

To check the stability of results, cross-validation data were gathered on 101 UCONN BSN students who graduated and sat for the nursing boards in July 1983. Simple univariate screening of the data suggests that both samples represent the same population (see, for example, Table 1). Differences in the two samples are discussed in the Results section.

GPA-GEN and GPA-NURS scores were generated from course grades built on objective exams. The GPA-NURS courses and their exams are built around specific behavioral objectives, so the content validity of the exams is fairly straightforward. GPA-CLIN scores are developed from four course grades, each based on low-inference, behavioral checklist observations of student performance in clinical settings. Each student received evaluations from a minimum of two faculty supervisors across four semesters. The reliability of these indices is not known, but is assumed to be in the range estimated by Humphries (1968) for adjacent semester grade-point averages, .60-.70.

The NCLEX is a multiple-choice test purported to reflect the five steps of the nursing process, and items are centered on critical incidents. Sanders and colleagues (1983) describe extensive content validation procedures and Rasch modeling for alternate forms of the exam, but no traditional reliability evidence is offered.

ANALYSIS AND RESULTS. For both the validation and cross-validation samples, standardized residuals were examined as a check for faulty data and outliers. A single outlier was detected in the 1983 data, in the prediction of the NCLEX score. The regression was repeated with and without the aberrant data; deletion of the outlier resulted in significant reduction in the

standard error of estimate, and the case was deleted from further analysis.

The path model shown in Figure 1 required five separate non-hierarchical multiple regression analyses, from which were derived the path coefficients. These coefficients represent the direct effect of each antecedent variable on each consequent variable, and are synonymous with the standardized Beta weights obtained from the regression equations. Thus, a complete set of 19 path coefficients comprise the saturated path model.

Because saturated path models may contain irrelevant causal paths, it is common practice to trim the model by deleting paths whose coefficients are too small to interpret. In this research, paths whose coefficients were nonsignificant ($p<.05$) were deleted from the model. For the 1982 validation sample, this procedure trimmed 15 paths and left only four. These four significant paths are indicated in Figure 2 by the numerical path coefficients. Like standardized regression weights, path coefficients may be compared directly with each other. For example, we may conclude that the influence of GPA-NURS is twice the influence of age on GPA-NURS.

Insert Figure 2 about here.

In the validation sample, it can be seen that among entry characteristics, only age develops paths to GPAs. The positive path coefficients from age to GPA-GEN and to GPA-NURS support the hypothesis that age is a direct causal influence of these indices. Following Land's (1969) interpretation of path coefficients, age is directly responsible for about a third of a standard deviation increase in GPA-GEN and GPA-NURS. Age, of course, is a proxy variable for other characteristics. Primarily, age allows the cumulation of other experiences. Evidently, these other experiences contribute in a positive fashion to a large portion of nursing coursework.

Only GPA-NURS shows a significant path to NCLEX, and its size suggests that a standard deviation improvement in GPA-NURS will deliver a .58 standard deviation increase in NCLEX scores. No entry characteristics give a significant path to NCLEX, but age is seen to operate indirectly on NCLEX scores, through GPA-NURS. In short, age seems to improve GPA-NURS, and in this way indirectly influences certification scores.

The absence of any influence of SAT scores is surprising and contradicts much previous literature. It was thought that this finding might be idiosyncratic to the small validation sample. But the SAT scores were also unimportant in the

cross-validation sample. And SAT scores did not show enough restriction of range to dampen their influence on later performance (see Table 1). It may also be that instructional efforts in the UCONN School of Nursing incidentally erase the impact of general ability.

In the cross-validation group, we see a few changes in the trimming process. Figure 3 shows the reduced path model, which may be readily compared to the validation model in Figure 2. The cross-validation data permit the trimming of 13 of the 19 paths of the saturated model. Although a quick comparison of Figures 2 and 3 suggests substantial differences between the two samples, we will see that the differences are easily explained.

Insert Figure 3 about here.

In the validation sample, age has a direct influence on coursework, and an indirect influence on NCLEX scores. But in the cross-validation, age shifts some of its influence through transfer status to course performance, and now shows a direct path to NCLEX scores. In addition, age now shows an indirect influence on GPA-CLIN, through transfer status. GPA-NURS is the only chunk of coursework that directly influences NCLEX scores, which is consistent with the validation results.

The positive path coefficients from age to transfer status, and from transfer status to GPAs, suggest that older students are more likely to be transfer students, and that transfer students are more likely to perform well on coursework. The implication seems to be that we may expect greater course achievement from older transfer students, and that those who outperform their peers in nursing lecture courses have a decided advantage on the NCLEX exam. Transfer students were accepted in the 1983 class at only half the rate of the previous class (see Table 1). If there was more thorough screening of transfer applicants in the later class, that may account for the improved relationship between transfer status and course performance.

The replication allowed by the cross-validation sample shows that the path results are fairly stable. Disturbance estimates for each consequent variable are shown in Figures 2 and 3. These estimates represent latent or residual causes that are not accounted for by the data, and are quite steady between the two samples. The major shift in disturbance shows up in the prediction of NCLEX scores. In the 1983 group, more variation in NCLEX scores is explained by variables in the model. (NCLEX variance accounted for, R^2, corroborates this: For 1982, $R^2 = .47$; for 1983, .63.) Figure 3 shows that age strengthened

the explanation of NCLEX performance.

DISCUSSION AND CONCLUSIONS. Bloom's Model of School Learning is not clearly supported by our findings. However, the central portion of his model deals with *instructional* behaviors, which we have not measured. The GPAs occupying the center of our path model serve only as crude substitutes for instructional behaviors.

Major findings of this research revolve around the influence of age on course achievement and on NCLEX scores. Older students typically have worked in nursing-related endeavors (such as LPNs or nurse's aides) before entry to the BSN program. Perhaps their work experience gives them a boost in entry cognitive skills that augments their course performances. At the least, previous work experience provides mental scaffolding for course material that might otherwise seem like rote memorization.

The lack of influence from age to GPA-CLIN is out of synchrony with age's effect on the other GPAs. On the surface, it seems that GPA-CLIN, unconnected by any significant paths, is an inconsequential part of the causal model. However, in the cross-validation sample, transfer status is seen to influence GPA-CLIN, at about the same magnitude as its influence on the other two GPAs. While that connection does not automatically justify GPA-CLIN (or GPA-GEN, for that matter), transfer students seem to have an advantageous repertoire of study skills, and it is a reasonable prediction that their higher GPAs may induce more skilled performance in the field. That prediction, of course, requires further research.

One may still ask why GPA-GEN and GPA-CLIN made no contribution to NCLEX performance. Bloom's (1964) argument that similar variables predict each other seems appropriate here: the concepts, skills, and testing involved in GPA-NURS are much more closely aligned with NCLEX content and test format. A tentative proposal from this finding is that certification exams should assess a broader domain of behaviors, particularly the sorts of applied nursing skills emphasized in clinical courses. A performance-based subtest, for example, might be more suitable, although it is unquestionably a more difficult form of assessment to develop and administer.

But there is little merit in developing a device only to reward academic behavior. We first need to show a relationship between the various GPAs and later performance on the job. If that relationship cannot be demonstrated, then it will be hard to justify additional certification test requirements based on GPA-GEN and GPA-CLIN. Finally, we eagerly await results from the California State Board of Registered Nurses' research on the job relevance of the NCLEX exam.

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TABLE 1

Means and Standard Deviations, 1982-1983 Samples[1]

	1982 (N = 72)		1983 (N = 100)	
	$\bar{X}$	S	$\bar{X}$	S
AGE	25.22	3.38	25.04	3.69
TRANSFER	0.43	0.50	0.22	0.42
GPA-GEN	2.47	0.46	2.62	0.63
GPA-NURS	2.61	0.35	2.49	0.55
GPA-CLIN	3.01	0.31	3.01	0.41
SAT-V	486.94	48.41	494.47	67.40
SAT-M	530.56	47.02	537.93	71.91
NCLEX	1954.72	223.07	2004.57	267.50

Note: AGE is years old; TRANS is transfer status (1 = yes; 0 = no); GPA-GEN is grade point average in general supporting courses; GPA-NURS is grade point average in nursing lecture courses; GPA-CLIN is grade point average in nursing clinical courses; SAT-V and SAT-M are Scholastic Aptitude Test scores, verbal and math; NCLEX is the nursing board composite score.

[1]SAT scores involve missing data: in 1982, only 36 students (50%) had them; in 1983, 81 students (81%).

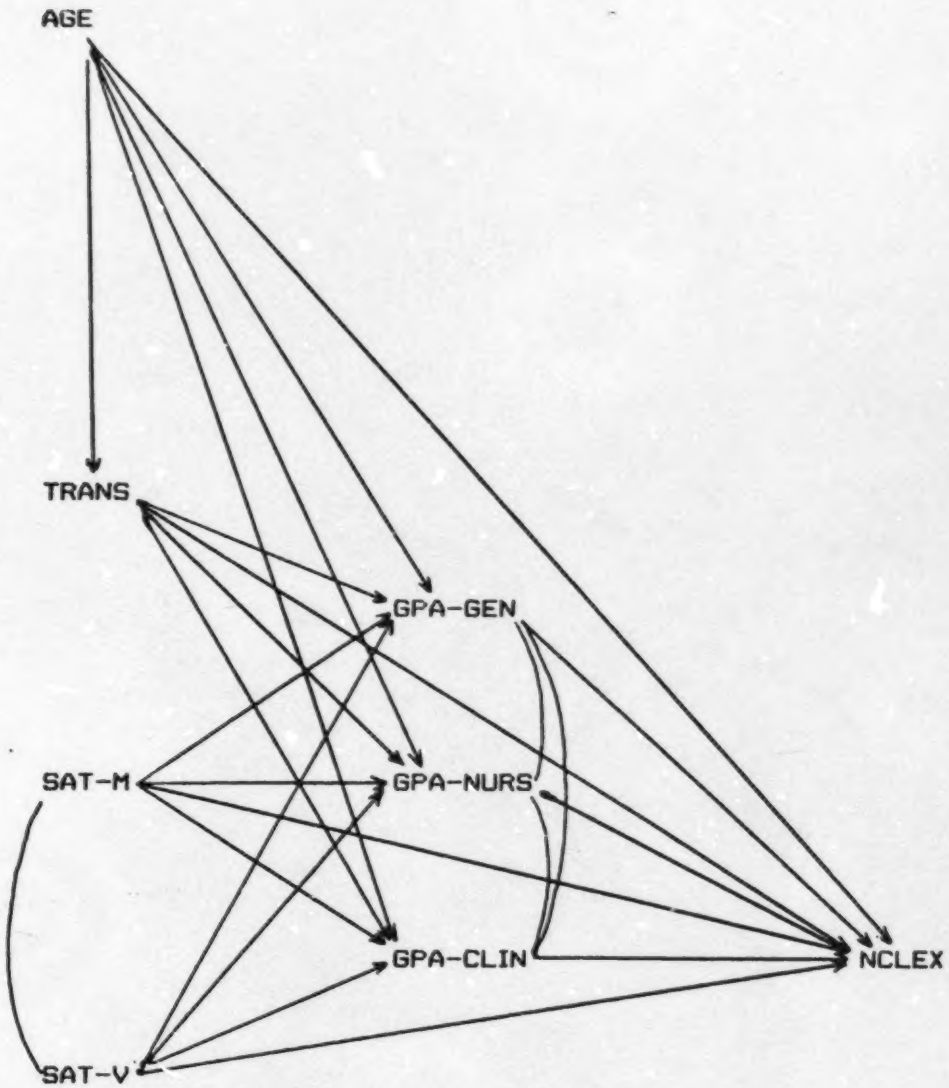

FIGURE 1. Saturated Path Model Explaining NCLEX Performance.
NOTE: Curved lines connect correlated variables where no assumption of causal influence is made.

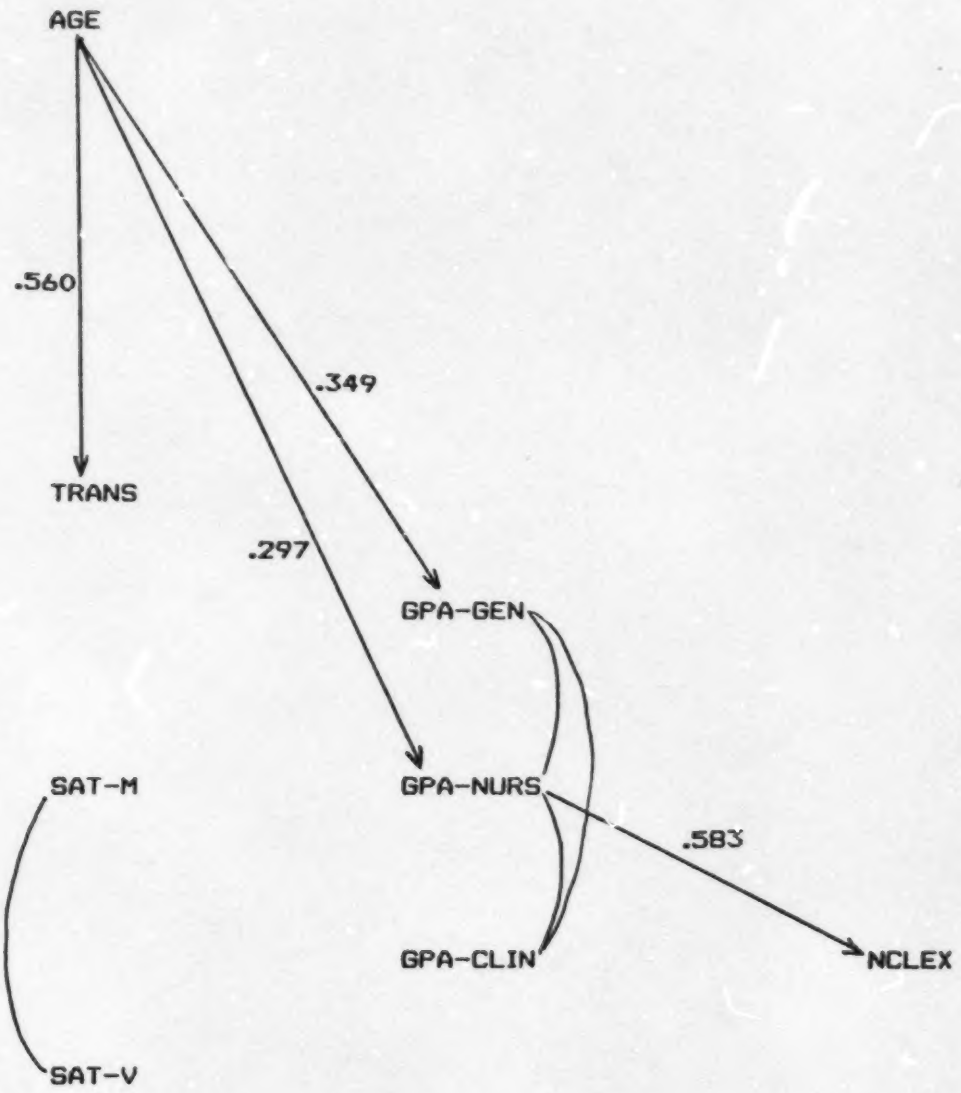

FIGURE 2. Trimmed Path Model, Validation (1982) Sample.
NOTE: Curved lines connect correlated variables where no assumption of causal influence is made.

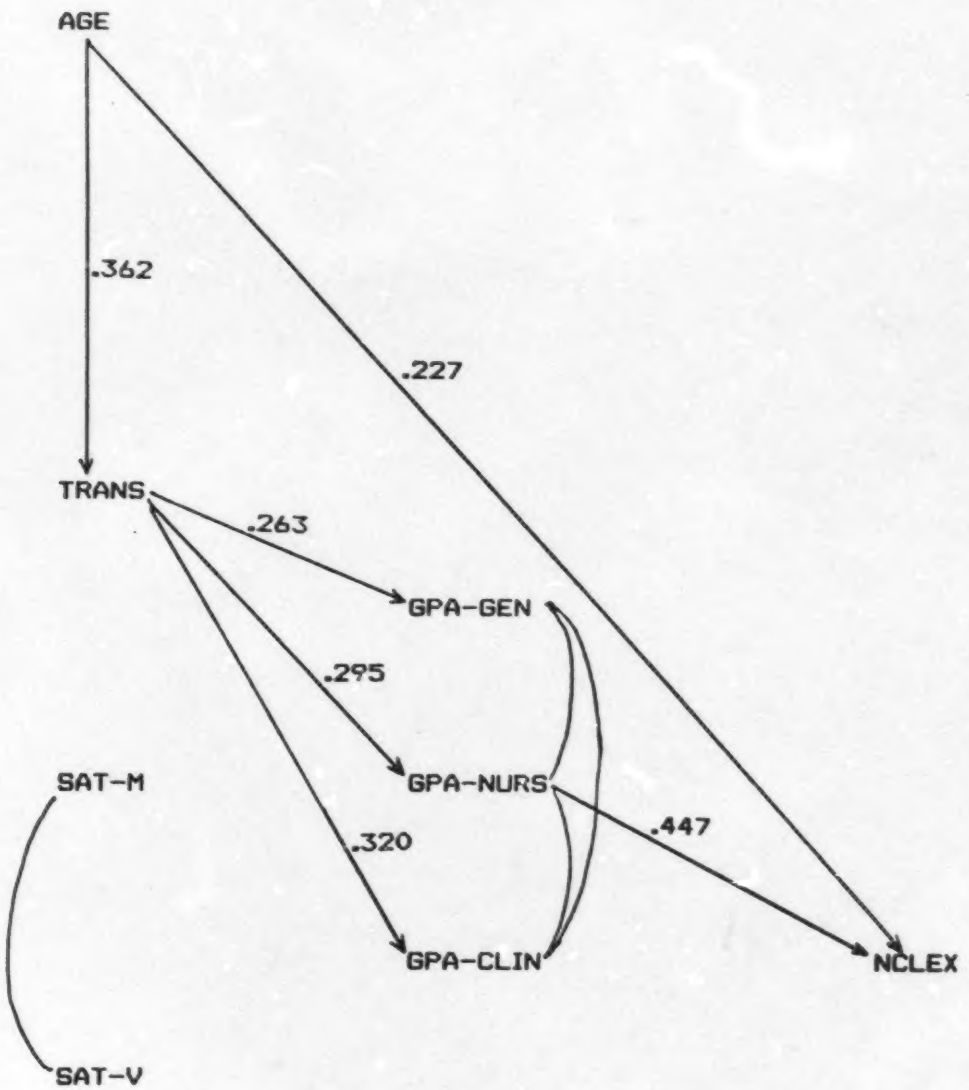

FIGURE 3. Trimmed Path Model, Cross-Validation (1983) Sample.
NOTE: Curved lines connect correlated variables where no assumption of causal influence is made.

Appendix A

Decomposition of Effects from Trimmed Path Models

	1982 SAMPLE			1983 SAMPLE		
	Direct Effect	Indirect Effects	Simple Corr.	Direct Effect	Indirect Effects	Simple Corr.
EFFECTS ON:						
transfer--						
from age	.560	.000	.560	.362	.000	.362
GPA-GEN--						
from age	.349	-.032	.317	NS*	.095	.143
from trans.	NS	---	.160	.263	.038	.301
GPA-NURS--						
from age	.297	.075	.372	NS	.107	.208
from trans.	NS	---	.323	.295	.050	.345
GPA-CLIN--						
from trans.	NS	---	.181	.320	.000	.320
from age	NS	---	.197	.000	.116	.099
NCLEX--						
from age	NS	.173	.244	.227	.147	.374
from trans.	NS	---	.213	.000	.132	-.020
from GPA-NURS.	.583	.106	.689	.447	.310	.757

*NS = nonsignificant effect.

CAUSAL INFLUENCES OF SELECTED EDUCATIONAL VARIABLES ON NURSING LICENSURE SCORES

Robin D. Froman & Steven V. Owen

University of Connecticut

Nursing curricula and licensing examinations have shifted toward the skills and processes of nursing. When these components are overhauled, their predictive relationship must be reexamined. This research tests the causal influence of several antecedent and achievement variables on licensure test performance.

A path model is developed from a theory of school learning, and the causal connections within the model are validated and cross-validated. Few significant paths are retained. Student age and transfer status show important influences on measures of school achievement and on licensure scores. Further, one broad measure of school achievement has a substantial direct effect on licensure scores.